Box 9. 136. e
135. b
Box III, 97. E. Box. 0045

REPORT

OF

VISITS TO CHEMICAL LABORATORIES

AT

BONN, BERLIN, LEIPZIG, ETC.

BY

CAPTAIN FESTING, R.E.

ASSISTANT DIRECTOR OF THE SOUTH KENSINGTON MUSEUM.

LONDON:

PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,

PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

FOR HER MAJESTY'S STATIONERY OFFICE.

1871.

28070.

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perature could not be kept low enough. A smaller room is therefore used for gas analysis.

The rooms originally intended for the assistants were appropriated for physical chemistry, but now Dr. Kekule's assistant, Professor Engelbach, uses them for instruction in analytical chemistry.

The large lecture hall holds from 160 to 180 students. The table in it is so elaborately fitted up as to deserve special notice. It is divided into three parts by two passages, but there are flaps to cover these openings, so that there may be a continuous table uninterrupted by anything right across the room. A portion of each of the side pieces is hung like a door, so that it may be turned back, and a space given when necessary for large apparatus on the floor. The top of the central portion of the table is covered with slabs of ground glass, painted white on the under side, and the whole surface is perfectly flush. A large water tank, formed of a metal framework with plate-glass panels, covered at the sides with wood panelling, which can be removed at pleasure, and at the top with a slab of ground glass, occupies the central portion of the table. At each end of the middle division of the table is a leaden trough, and towards the front edge of the table are two small troughs for mercury. These also are covered with slabs of plate-glass. The rest of the glass top is fixed. On the table are two small sinks for liquids, and four holes of about an inch diameter, which communicate under the floor with flues, so that noxious fumes evolved in experiments may be conveyed away.

The gas cocks are all placed on a recessed shelf along the back of the table, and fixed to the edge of the table above them is a slip of wood perforated with holes for flexible tubes to pass through, so that the tubes are protected where they bend over the edge of the table. Supports for tubes, &c. can be screwed on to the edges of the mercury troughs when necessary.

Along the front of the table are hooks, to which can be fastened an arrangement of gaslights, somewhat similar to the footlights in a theatre, to light the table at night. The great point aimed at in the arrangement of the table has been to have a continuous level surface uninterrupted by any apparatus not actually in use.

Behind the table is an evaporation closet and two furnaces, one for metallurgical work, the other for heating retorts, &c. The latter has two vents into the flue, one near the top of the furnace, the other below the furnace bars. When the damper of the ashpit is open, and the

plate is on the top of the furnace, the latter is in its ordinary working condition; but before taking out or putting in a retort the bottom damper is closed, then on removing the plate at the top the draught descends through the fire and passes into the flue by the lower opening.

At present there are no furnaces for the use of the students. But the Government has given a sum of money for their construction, which will be carried out this year.

There is no boiler for supplying steam for use in the Laboratories. Distilled water is obtained from the steam-engine which pumps water to the tanks on the roof of the building.

There is, however, a small steam apparatus made by Mürrli, of Pforzheim, in Dr. Engelbach's laboratory, of which he speaks very highly. It is somewhat similar to one in Professor Galloway's laboratory in Dublin. It consists of a small boiler, with places above it for evaporating pans. The steam passes among these and over to the left, to heat a sand bath, whence it passes into a still. On the right side of the boiler and touching it is an iron plate, which is thus kept moderately warm, and forms the bottom of a glazed closet, which is very suitable for gentle evaporations, or for evolving sulphuretted hydrogen in the usual way.

There is no special apparatus for sulphuretted hydrogen. It is made as required in the usual way.

In the basement is a holder for oxygen, made of boiler plate, about 5′ diameter and 5′ high. The pressure is maintained by admitting water from the tank on the roof, which gives a pressure of nine centimetres of mercury. From this the supply is laid on to the lecture theatre.

A great feature is being made of the collection of products, which is arranged in a very methodical manner in a special room.

The whole establishment is kept in very good order, and is remarkably clean and tidy. The greater part of the students were absent on account of the war; perhaps when in full working it would be difficult to keep it in such an excellent order; but as an example of the extent to which order is kept up I will mention that every bottle and its stopper is marked with a letter and number, so that if left lying about a bottle may be at once restored to its proper place.

Dr. Kekule considers that generally in this building too much has been expended on magnificence of effect.

The large halls and corridors occasioned a considerable outlay, and would entail considerable loss of time in getting

about the building, which would be much better if more compact. The laboratories for the students are very convenient and well lighted, but unnecessarily large for the number of students, whereas some of the rooms, particularly the operation rooms, are too small.

But the great defect is that there is no ventilation and no general system of warming. Stoves have been put into each room, but steam or hot-water pipes would, Dr. Kekule thinks, be far preferable.

A great advantage in this building is its position, being apart from all other buildings and open all round.

BERLIN.

I paid my first visit to the chemical laboratory here on the 10th May, but Dr. Hofman being engaged all that day I returned to it again on the following day, when he was able to go round with me and show me over the whole establishment.

We have already Professor Hofman's description of the general arrangements of this laboratory ; there is no need, therefore, for me to refer to anything but the details and those points to which my attention was specially drawn by Professor Hofman. Here, as at Bonn, in consequence of the war, comparative few students were at work.

The students' working tables are similar in size and general arrangement to those at Bonn, but are in groups of four, with washing basins at both ends. As at Bonn, all bottles and stoppers are numbered, but the shelves of each student are closed in front by a rolling shutter hung with a counterbalance, so that each student can lock up his reagents, &c.

Professor Hofman pointed out how very advisable it is to have very large traps to the sinks, so that any acids thrown in may be at once diluted with a large quantity of water, and be less destructive to the waste-pipes, &c.

On each table is an earthenware jar for the student to deposit his filter papers in, instead of throwing them into the sinks. These jars are emptied daily.

Professor Hofman considers that with a large space in the working rooms, and properly ventilated evaporation closets, there is no need for arrangements for the general ventilation of the rooms. Notwithstanding, however, the small number of students at work the atmosphere in the rooms was decidedly unpleasant.

My attention was particularly called to the advantage of having light on both sides of the closets for operations

causing evolution of noxious vapours. Students can then keep all their apparatus entirely in the closet when at work, and need not withdraw it to get better light on it. These closets are made in the thickness of the walls, and are glazed on both sides. They are 5′ or 6′ long.

Professor Hofman laid great stress on using earthenware wherever possible. The dampers of the flues, for instance, are all of earthenware instead of metal.

The lecture theatre, which holds 220, is fitted somewhat similarly to that at Bonn, but the fittings of the table are not so elaborate, nor I think quite so convenient. The gas lights are overhead, and are supported from the table. The top of the table is of wood, painted or stained black. There is a down-draught flue from it, and sinks, &c. in it. A large earthenware sink with a perforated earthenware tray and a moveable top can be used as a pneumatic trough. The plug of the sink is of earthenware also.

Oxygen is supplied to the table from a holder in the basement. By turning a tap on the table water is admitted to the holder, the pressure in which is indicated by a gauge behind the table.

In the lecture room, as in all other rooms, are tablets of ground glass painted at the back, fixed to the wall for use as slates, the pencil being composed of French chalk. They seem remarkably handy.

The glazed-in corridors form convenient places for some descriptions of work. In them are two stills, consisting each of a small steam boiler, the steam from which heats a set of drying closets, passes through the cistern which supplies the boiler, and thence into the worms from which the distilled water is drawn off. In another part of the corridor is an air pump with 18 plates, each with a cock, so as to be used independently of each other. This is said to be very convenient.

The gas analysis room is lighted from the north only, and the windows are double glazed, in order to ensure uniformity of temperature.

More use is made here than at Bonn of the out-of-door places or "loggie." Each is fitted with a bench, with gas and water laid on, and has a strong iron box for containing tubes, in which substances can be heated if there is danger of explosion.

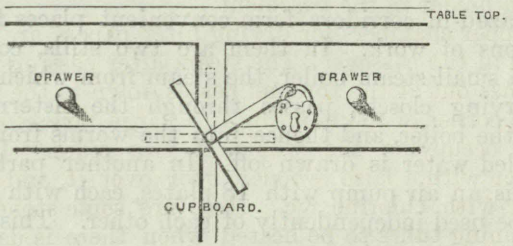
The lecture theatre and larger rooms are heated by hot water. The Professor's laboratory and smaller rooms by stoves.

The building suffers much from its confined position in respect of want of air and light, but it has the advantage of greater compactness than that at Bonn.

LEIPZIG.

I visited the Chemical Laboratory here on the 15th May, when Professor Kolbe kindly showed me over it. I append to my report a published description of this laboratory.

The arrangement of the students' rooms is much the same as at Bonn and Berlin. The students' tables are arranged four in a group. Each elementary student has a space 3′ 6″ × 2′ 3″, each advanced student 5′ 0″ × 2′ 3″. The washing basins and sinks are at the ends of the tables. The shelves are not locked up as at Berlin, but there is a very convenient method of locking up the cupboards and drawers under the tables. A T-shaped piece of metal is pivotted where the arms meet to a point between the ends of the drawers and the top of the cupboard. This is poised so as to rest in such a position as not to interfere with the opening of the drawers or cupboards; but by tilting it at an angle one arm prevents the cupboard being opened, and each of the others comes in front of a drawer. It is secured in this position by a padlock, which the student provides.



Thus the endless expense of renewing locks on drawers and cupboards when they get corroded by chemicals is avoided. Inside the cupboard each student has a drawer for glass tubes, which reaches through the opposite cupboard and is thus over 4′ long. Between each pair of students is a recess under the table top, in which is a lead trough for the reception of filter papers. The trough drains into a pitcher in a cupboard below. The lead troughs are movable, so that they can be readily taken out to be cleared. Each student has gas and water laid on to his place, and there is a Bunsen's air pump to each pair of students.

To each group of four students there is an evaporation closet. Two sashes are so hung in front of the closet that air may be admitted either at the level of the sill, or half-way up. The upper sash is the full size of the front, the lower sash one half the height, and so arranged that it can be moved down far enough to allow of the upper sash being cleaned inside at the top.

There is a double steam closet, and a sand-bath heated by gas in each laboratory.

The rooms throughout are heated by "Swiss" stoves, consisting of an upright iron cylinder, 6′ high and 2′ diameter, into which steam is admitted at the top; the water is allowed to occupy half the height of the cylinder.

Air is admitted to each laboratory by a shaft about 2′ square, opening about 2′ below the ceiling. In this shaft is one of the stoves. In the diagonally opposite corner of the room is an extract shaft of rather less size, with two openings into it, one just above the floor, the other a little below the ceiling. Either of these can be closed at pleasure. This system seems to work well.

There are large well lighted rooms for large distillation and blowpipe work. Gas, steam, and water are laid on to these rooms.

Next to these is a room specially devoted to sulphuretted hydrogen work. The sulphuretted hydrogen is laid on from a holder in the basement.

The copper chambers for drying filter papers are let into the walls in the passage. The steam after passing through them comes out at the top and passes down to the still.

At the corner of the building is a large airy room, with windows occupying the whole of two sides. It has a stone floor with a false wooden floor over it, and is used for work with chlorine, &c. Here are some stone niches for containing tubes to be heated when there is danger of explosive gas; water and steam are laid on to it.

There is an "open air" working place on a portion of the roof, but judging from the fact that the water supply pipe was burst, apparently by the winter frost, this place does not seem to be much used.

The room for combustions has an oxygen holder in it, the pressure in which is maintained by water from a small cistern. The oxygen is laid on to each working table, over each is a hood.

The gas analysis room is supplied with gas and water. The floor is laid at a slight slope and covered with floor cloth, which is turned up over a fillet running round the

skirting, so that any mercury which is upset collects at one place and may easily be recovered.

There was nothing remarkable in the fittings of the lecture theatre, except a reading desk, which is hung with a counterweight in such a way that it can be shut down flush with the table top when not required. Water, gas, steam, compressed gas, and compressed air are all laid on to the table. The air and gas are compressed by the "water blow-pipe."

The system of roof covering used throughout the building is worthy of notice. It consists of five thicknesses of stout brown paper, soaked in Stockholm tar, laid on boards. Then comes one inch of sand, and over that a layer of small pebbles, apparently quartz. This is said to answer very well.

Physiological Laboratory.

The following day I visited the Physiological Laboratory and called on Professor Ludwig, the Director, who introduced me to an American, Dr. H. P. Bowditch, who is studying there, and who kindly showed me over the establishment.

In "Nature" of 22nd December 1870, at p. 172, is a description by Dr. Bowditch of the general arrangement of the laboratory.

It is divided into three sections. One a chemical laboratory, a second for experimental physiology, and the third for microscopic work.

The rooms for chemistry are fitted much as other chemical laboratories. The dissection rooms are fitted with plain tables, and with zinc covered tables for operations. In each room are small evaporation closets.

Motive power is supplied to each room to work apparatus for inflating lungs, &c. It is derived from an Otto's single action gas engine in the basement, and is transmitted by shafting along the passages.

In each room are various appliances, some of a highly delicate and intricate construction, for performing and recording the results of operations.

An injecting apparatus in one of the rooms is said to be of great use. It consists of a set of jars, the air in which is compressed by water admitted from the service pipes, the constancy of the pressure is maintained by a particular arrangement of the tap. The compressed air passes into wash bottles charged with the liquids to be used. A

water bath keeps these liquids and the tissues, &c. to be acted on at a convenient temperature.

Small water baths heated by gas are much used for heating substances under examination. The water in these is maintained at a constant temperature by a very ingenious arrangement invented by Professor Bunsen. The gas enters a glass vessel containing mercury, and closed at the top by a cork, through which is passed a tube for supplying gas to the jet. The vessel is placed in the bath; as the mercury expands it rises towards the end of the tube which passes through the cork of the vessel, and if the heat is too great closes the tube.

Pure hydrogen is obtained by a very handy apparatus consisting of a glass vessel, in which water is decomposed by galvanic action; the oxygen being taken up by an amalgam of zinc and quicksilver as fast as it is evolved.

One room is devoted to operations requiring the use of quicksilver. Here is a very ingenious process for extracting gases from the blood or other fluids. Two glass globes are connected by an elastic tube, by raising one the other becomes filled with quicksilver, it is then put in communication with the vessel containing the blood; the first globe is then lowered, the mercury thus leaves the other and makes a vacuum in it, which draws the gases off the blood. By now again raising the first globe the gas is pumped into a proper vessel.

The rooms for working are all on the ground floor, and form three sides of a nearly square rectangle. The lecture room is in the enclosed yard, and abuts against the back of the middle or eastern side. Instead of a continuous table for demonstrations, it is fitted with three tables, each about $5' \times 2'$, mounted on wheels to run on rails across the room. There are means of darkening the room, but no other special fittings. The area of the room is about 1,000 feet, that of the rest of the building is about 8,500 feet. On the first floor of the building are the residences of the Director and other persons connected with the laboratory.

In the basement are stores, the gas engine, a workshop for repair of apparatus, &c., and places for keeping live animals. Outside is a tank for frogs and a cage for birds, also an outbuilding fitted with a sling and a large operating table for operating on horses or other large animals, and stalls for keeping them in.

The entire expenses are borne by the Government. There are nine or ten students.

(The work done consists entirely of original investigations, and I understand that no students are admitted who are not capable of performing them. In this respect it would be quite different from any institution which we might have here.)

MUNICH.

At Munich are four chemical laboratories, but that which has most recently been constructed, and which Professor Liebig informed me was best worth seeing, is that at the Polytechnic School. I went over it with the Professor, Dr. Erlenmeyer, on the 22nd May.

The laboratory rooms are all on the ground floor of a building which is the south wing of the school, and faces about E.S.E. Half of the wing is devoted to chemistry, and over the laboratory is the residence of the Professor.

There is accommodation for 36 students, but by working at different times 60 receive instruction there.

There is a large room for beginners, which has working places for 24. Its aspect is S.S.W., and it has windows along one side and at both ends. These places are arranged in groups of six, 3′ 6″ being allowed for each student. Alternately with these working benches, which are much of the ordinary pattern, are flat topped working tables, the pedestals of which contain cupboards and drawers for the apparatus of the extra students.

There is a space of about 6′ clear between the bench and table, and of between 5′ and 6′ clear between the ends of the benches and the windows on one side and the evaporation closets on the other. At each working place gas and water are laid on, and there is a small waste-pipe from the surface of the table, into which the end of a flexible tube may be introduced ; but there are only six or seven washing sinks in the whole room. Some of these have shallow earthenware basins, others have deep troughs cut out of solid stone.

Each student has a Bunsen's air-pump at his bench. (The fall is about 20′.) To the tables are laid on gas and water, and compressed air from a water blower, and suction from a large Bunsen's pump.

Along the side of the room opposite to the windows is a range of evaporation closets, of which one, lined with tiles, is used for sulphuretted hydrogen, which is made here in the usual way by each student (Dr. Erlenmeyer prefers that students should do these things for themselves). The

other closets contain stone niches made of slabs of serpentine put together. These are found not to answer, as the vapours are condensed on the surface of the stone.

Dr. Erlenmeyer pointed out to me that it was a great thing to have the sashes of the closets made to open so high that a student can work with his head inside the the closet (or partially inside).

In this room is a small boiler and still. The steam heats one of the ordinary pigeon-hole drying closets, as well as a copper box for drying precipitates, &c.

The rooms are all heated by hot air, which Dr. Erlenmeyer does not like. He would prefer steam, but there is no space now for a steam boiler.

There is also a room for investigations for 12 advanced students. The working places are in groups of four, 5′ being allowed to each. Here are large evaporation closets, enclosed with sashes, a slate slab at the bottom, and lined at the back and sides with tiles. Air is admitted to them from the outside. There is a stand for small copper baths, heated by gas; this, as well as the pedestals of the evaporation closets, is covered with glazed tiles, which are said to be cheaper (?) and better than woodwork.

A still is so placed that the flue from the fire heats one adjacent section of the evaporation closet, which is cut off from the rest. The steam heats a nest of copper drying boxes, and is laid on to the large closet besides.

Two glass covered courts about 32′ × 24′ afford space for rough operations, blowpipe work, &c. Each has a large table in the middle, with gas, water, suction, and blowing laid on. The taps, as in all cases where a level table is required, are in a recessed shelf below the table top, and holes are pierced through the latter for flexible tubes to pass through.

There is also a large glazed closet, with gas, water, &c. laid on, and it, as well as the table, has small waste-pipes opening flush with the surface to receive the ends of flexible tubes. The ventilating flue from the closet starts from the level of the slab, and the gas jet to make the draught is placed at this level, where it is less liable to be blown out than if it were at the upper level, where there is an opening for taking off the foul air. The dampers for the openings are of earthenware.

From one of these courts is the entrance into the glass store, which is under the seating of the lecture room.

The lecture-room is very simply fitted up. There are no furnaces in it. The table has one lead-lined pneumatic trough in it, the cover of which is flush with the table. Dr. Engelbach prefers using movable glass vessels, about 16″ diameter and 5″ deep, mounted on wooden feet for most work.

There is an oxygen holder in the room, and gas, water, suction, and blowing are laid on to the table.

The Professor's private laboratory is about 17′ × 14′. Next to it is his study and office, about 17′ × 9′.

There is a large closet in this laboratory for evaporations. The slab is of stone. Air is supplied to it from outside. All the sashes and frames can be taken away, so as to leave only the slab and hood. Gas, water, suction, and blowing are laid on to the closet. The pipes pass along the front just under the slab, and are covered with a slip of wood, which can easily be removed. The sash at the end of the closet can be removed independently of the others. In another part of the room is a slate slab with hood over, but no sashes. It is supplied with gas, &c. The brickwork supporting the slab, as everywhere else, is covered with glazed tiles.

In the middle of the room is a flat working table, gas, water, &c. laid on, and waste pipes in the table.

In order to accommodate all the students work commences at 8 a.m., and lasts all day until 7 p.m. The laboratory was kept in excellent order.

MUNICH.

In a building adjoining the chemical laboratory is that for physics. This has only very recently been instituted. I called on the Professor, Dr. Beetz, who very kindly accompanied me over the building. It consists of two principal divisions, one comprising all that relates to lectures, the other the working rooms for students.

The first division consists of a room about 45′ × 25′ for apparatus. That of each subject is kept in a separate case, and the collection appeared to me to be very complete. Dr. Beetz was good enough to devote some time to showing me this apparatus and explaining the uses of the various articles, many of which were quite new to me; but any description of them here would be out of place.

Next to the apparatus room is that for lecture preparations, about 12′ × 25′. Here is the large magnet, each

cylinder of which weighs 500 lbs. A battery of 36 elements is used in connexion with this. Between this and the lecture room is an opening in the wall fitted with shutters, which contains the large induction coil.

The lecture room is intended to hold 150, but a larger number are generally desirous of attending the lectures, and some are consequently unable to get in.

The demonstration table extends across the room, which is about 25′ wide. Gas and water are laid on to it, also oxygen, from a holder about 5′ high and 2′ 6″ diameter (said to be twice as large as necessary) in the preparation room.

The poles of the large battery are on the table, also those of a galvanometer, the dial of which is placed in a vertical position above the blackboard behind the lecturer, and is so large as to be easily seen from any part of the room.

The working rooms are arranged en suite, opening out of a well-lighted corridor 10′ wide.

First is the Professor's private laboratory, about 24′ × 20′. Next a room for electricity, 24′ square. Then a dark room of about equal size. An arrangement is made for admitting a sunbeam into this room.

All these rooms have steady stone platforms about 3′ square, built up independently of the floor for carrying the instruments used.

The corridor is also used for work. Small tables are fitted along under the windows, and along the wall are ventilated closets for batteries and cases for balances and apparatus.

A photographic dark room and a small workshop with lathe, &c. for repairing and making apparatus complete the establishment.

As in the chemical laboratory the Professor's residence occupies the upper floor.

ZÜRICH.

I was at Zürich on the 25th and 26th May, and Dr. Wislicenus (the Professor of Analytical Chemistry), to whom Dr. Frankland had kindly given me a letter of introduction, showed me over the University and Polytechnic School.

These are contained in a very fine and well-situated rectangular building, about 430′ × 250′, inside which are two open courts, each about 110′ square. The building consists of three stories and a basement. Its greatest length is

nearly north and south, and it faces west. Behind, in a detached two-storey building, are the chemical laboratories.

The northern half of the building comprises the Polytechnic School, and the southern half the University. The collections and the large "Aula" are common to the two.

There are spacious entrance halls and staircases at the middle of each side and of each end.

One side of the ground floor is occupied by class rooms for mechanical engineering and architectural drawing. These are very well lighted rooms. Each student has a table and board (about 2′ 6″ × 3′ 6″) to himself.

The other side is devoted to physics, and contains a room for the Professor, a lecture room for 170 students, an apparatus room, and a series of class rooms. In the basement underneath are a large laboratory and two or three smaller working rooms, a workshop, and a room fitted for rough work with a forge, washing place, &c. (Here was an example of the unsuitableness of stone for the floor which was much damaged by acids.)

The east side of the first floor is devoted to the mineralogical, palæontological, and geological collections. These rooms are lofty and lighted from both sides. In the remaining portions of this floor are two libraries and a number of class lecture rooms for various subjects.

The east side of the second floor is devoted to the zoological collections. At one end are the mammalia; at the other reptiles and lower animals. In the middle is a large lecture room. The rest of this floor is occupied by the large "Aula" of the institution, the senate room, a small physiological laboratory, and sundry small class lecture rooms.

The corridors of communication to the various rooms run along the inner side of the rooms, and are well lighted from the interior courts. They are 10′ or 11′ wide.

The two interior courts are separated by a one-storey building, containing a collection of casts of sculpture, &c.

The collections are all open to the public at certain times on payment of a small entrance fee.

The building containing the chemical laboratories is about 200′ × 60′. It consists of one storey, with rooms about 20′ high, and a half sunk basement, with vaults about 9′ or 10′ high.

The entrance is in the centre of the length. One half of the building is appropriated to analytical chemistry under Dr. Wislicenus, the other to technological chemistry under Dr. Kopp. A wide central passage gives access to the rooms.

There are 54 students at present in the laboratory for analytical chemistry, but more are expected next session, and it will then be overcrowded.

The rooms consist of,—

Professor's office, about 22′ × 16′; next, his laboratory, about 22′ × 12′ or 13′, which he finds too small; next, the balance room, 22′ × 24′, which contains also the library, and a collection of minerals for analysis. Then, at the southern end of the building, with windows at two adjacent sides, a working room, about 30′ × 22′, for 20 advanced students.

The working tables are arranged in groups of eight, with the ends against the piers between the windows. The tables are very simple, 4′ width allowed to each student; gas and water laid on; one washing basin for two or four. The usual drawers and cupboards, and shelves for bottles.

There are no evaporating closets in the room. Some small steam drying closets are let into the wall and against the back wall are three or four Bunsen's pumps.

Next to this is a room about 30′ × 22′, for larger operations. In this are evaporation closets, steam baths (heated by wood fire), and a range of small furnaces, giving enough heat to melt nickel. There is nothing very special in the fittings in this room.

Next is a room about 30′ square for beginners. Here the working tables are rather crowded, and the space given to each student is rather less than in the room for advanced students. There is a closet about 6′ long for sulphuretted hydrogen work. This gas is laid on from a holder in the basement. A number of small sand baths, each heated by a gas jet, are contained in another closet.

A room for collections about 20′ × 22′ comes next. Here is also kept a pump for liquefying carbonic acid, and such work.

The lecture room, 26′ × 22′, is very simply fitted up. Gas and water only are supplied to the table. There are troughs and sinks in the table, with flush covers. The top of the table is of wood.

Opposite to the lecture room is a room for gas analysis. It is about 22′ × 12′. The aspect is about E.N.E., and there is said to be too much sun.

There is no lecture preparation room, which is much wanted.

The basement contains two rooms for rough work, combustions, &c. Hoods are fitted for carrying off the products. In one of them is a still for water.

There is a series of store rooms for chemicals, fuel, &c., also a dark room about 20′ × 12′. A room about 20′ square for keeping live animals used in physiological research, and beyond this a room 16′ × 12′ for forensic work, investigation of poisons, &c.

The sulphuretted hydrogen holder, which is 6′ in diameter and 4′ high, is in a room by itself.

The rooms of the ground floor are heated by steam in upright pipes 8″ diameter.

There are extract ventilators in the ceiling.

The floors are of asphalte, which Dr. Wislicenus says is not found to be too cold to the feet, and which he prefers to any other material for the purpose.

Laboratory for Technological Chemistry.

Dr. Kopp, the Professor, was good enough to show me over his laboratory. He told me that he had 70 students, though the building was intended to accommodate only half that number.

The rooms are arranged somewhat similarly to those in the other half of the building, but the space is not so much subdivided, so that there are fewer but larger rooms.

The lecture room, which holds about 100, has no preparation room, there is merely a closet formed in the thickness of the wall behind the black board and closed with sashes.

The table is very simple. It is covered with glazed tiles and has gas laid on.

Dr. Kopp said that a preparation room was very much required. At Turin he had a very fine laboratory, where was a very convenient arrangement of a truck running on rails from the preparation room into the lecture room. By this means experiments which were offensive by reason of smoke and flame were possible, as immediately the matters used were done with they could be wheeled bodily out of the room.

Next to the lecture room is the Professor's office, about 22′ × 20′ and next a laboratory 32′ × 22′ at the corner of the building for the Professor and his assistants. There are windows along one side and one end, and along the opposite side a range of sand baths some of which are heated by steam and others by a fire underneath. There is a small glazed closet with ventilating flues at the end of the room. In the centre of the room is a large working table covered with glazed tiles, and with gas laid on. Next is a room for students about 50′ × 32′. The working tables are

arranged in groups across the room and along under the windows. The room being at the corner of the building is lighted from one side and one end. The tables are simple and similar to those in other laboratories; 4′ in width is the proper amount for each student, but two have to work at one place.

At the end of the room is a large glass enclosed closet, with 12 steam baths, each supplied with steam by a distinct tap. The condensed steam returns to the boiler.

Along the side of the room is a glass enclosed closet, with a bottom of glazed tiles for evaporations, &c. over gas.

At several places in the room are Bunsen's air-pumps.

The *collection room*, 32′ × 22′, contains apparatus for lectures, minerals, specimens of products, &c.

The *balance room*, 20′ × 22′, contains also air-pumps. The shelf for the balances is fixed to the wall, and so being independent of the floor is not shaken by people walking about the room; but from the balances being "end-on" to the light they cannot well be seen.

The rooms are heated by steam in horizontal pipes above the floor. In the ceiling are extract ventilators connected with ascending flues. The rooms appeared to be fairly well ventilated. The floors are of asphalte.

The basement contains at its two corners small vaulted rooms for offensive and dangerous work. There are no flues from them, but the windows alone are relied on for removing the fumes. Two other larger rooms are in communication with them, and are used for rough and dirty work. Furnaces, steam boiler for supplying steam closets and baths, &c. A small copper steam box for drying things in close proximity to it. A still for condensing the vapours, if necessary. There is a large stone working table, with gas laid on; also a wash-up place, &c.

Another working room about 30′ × 22′, in which experiments with dyes were going on. It is provided with a working table, &c.

Two store closets each about 30′ × 10′. Into one of these is brought through the wall the pipe from the still used in preparing ether, which is collected here to avoid danger.

A vault for the steam boiler used for heating the building.

A vault about 22′ × 10′, with yellow light, and another of equal size, which can be entirely darkened with a shutter.

A third room of about the same size for combustions of organic substances.

In the centre of the basement is a large open space for packing and unpacking, and in an open vault near it a calorimeter for determining the heating power of combustibles.

These laboratories were not so luxuriously fitted up as others which I had seen. But the arrangements all appeared to be serviceable.

HEIDELBERG.

I arrived here on the 6th June, with letters of introduction to Professor Bunsen, who kindly showed me over his (chemical) laboratory, which I found to be well worth seeing, although it has now been constructed 16 years. Professor Bunsen is of opinion that a laboratory should not be too "elegant," and his certainly is not so; but it looks thoroughly workmanlike.

The usual number of students is from 50 to 60 or 65, which last is the utmost number that can be accommodated; but now, in consequence of the war, the number is reduced to from 40 to 45. The superficial area of the building is, I should think, about 11,000 square feet, but I was unable to get the dimensions exactly.

The two principal working rooms are in the central part of the building. They are separated by a longitudinal wall in which are the flues, so that each room has windows along one side, and a range of hoods, sand-baths, and still on the other side.

The working tables are arranged in pairs, back to back, in one room, and in groups of four in the other. There are also places along under the windows. The construction of these tables is not remarkable, except that each student has a small closet about a foot square and 1′ 6″ high on his table at the end of the bottle shelves. This closet is lined with zinc, and has a glass door. From it a 1″ extract pipe passed into an earthenware tube under the floor. This tube conducts the air from several closets into the ashpit of the nearest sand-bath. These ashpits are in the basements, and are walled up close, so that the furnace draws its air through the tubes from the stink closets. This system is found to answer well.

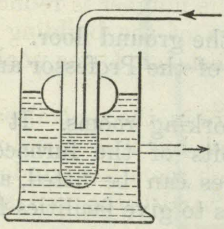
The sand-baths are in an opening in the wall between the two rooms, they are enclosed with glazed sashes, and divided by a sash in the line of the centre of the wall.

The opening in the wall reaches nearly to the ceiling, and the sashes reach to the top of the opening, so that there is plenty of headway when the lower sash is put up for working.

On either side of the sand-baths are hoods extending over stone slabs, on which are small water baths.

About 6′ below the roof the flues from these hoods open into those from the sand-baths.

The water-bath apparatus is peculiar. Each consists of a porcelain jar about 3½″ diameter and 9″ deep, having an opening about half way up, to which water is admitted by a flexible tube. Resting in the top of the jar is a porcelain vessel of the shape of the inverted frustrum of a cone which carries the capsules used. This is held in an ordinary support, and has a gas flame under it, and over it a small earthenware hood about a foot in diameter, which opens into a drain-pipe flue carried up 6′ or 7′ into the flue from the large hood. Under each large hood is a set of six of these apparatus. The level of the water in each set of apparatus is kept constant by a feeding apparatus with which each jar is put into communication. A glass tube having round it a bulb containing air, and in its lower end some mercury floats in a cylindrical glass vessel. The feed water is brought by a pipe which passes down this inner tube, and is sealed by the mercury until the float drops below a certain level. When this happens the feed water fills and runs over the edge of the tube into the outer cylinder which is in communication with the baths.



Under each hood also is a glazed closet about 2′ wide, 2′ high, and 1′ deep for sulphuretted hydrogen work. This closet has a special flue which is carried up alongside of the flue from the sand-bath furnace, and is separated from it by only a thin stone wing.

At one end of this working room is a room about 12′ × 14′ for blow-pipe and other rough work, and behind it a store room of about equal size.

Next a room about 22′ × 12′ for offensive operations. This is at the corner of the building. It is furnished with a large hood under which are portable charcoal furnaces, also a large stone table in the middle of the room.

From the passage outside this room is the door leading to a small verandah for open air work. Here is a stone slab and small portable furnaces. Gas is laid on.

Next is the gas analysis room about $22' \times 9'$. Below it is the ice cellar, which aids somewhat in keeping the temperature low. There is no special arrangement of floor for catching mercury.

Next is a room of about the same size for electrolytic experiments, and used also for combustions.

At the other end of the building is the lecture room (rather small), with a preparation room next to it. The lecture room is only about 22′ wide, and by no means elaborately fitted up. There is an extraction flue about 3″ diameter from the surface of the table, which goes to the ashpit of the nearest sand-bath furnace. Various appliances can be fitted on to this. There were no other special fittings to the table.

Adjoining one of the working rooms is the Professor's private laboratory, about 22′ square, and fitted up like the students' rooms.

A room about $22' \times 20'$ contains the balances, air-pump, and library.

This completes the list of rooms on the ground floor.

On the first floor are the residences of the Professor and his assistants.

In the basement are no regular working rooms. It is all vaulted, and in it are the ashpits of the furnaces. Small openings, to which flexible tubes can be fitted, are made in the walls of these ashpits so as to give facilities for making evaporations and filtrations.

Here is also the heating apparatus. It consists of furnaces in which are iron pipes through which air passes from the outside into the rooms above.

The gas and water mains are carried along under the crowns of the vaults.

There is a well 40′ deep for the suction apparatus.

The floors throughout the building are of asphalte, which Professor Bunsen considers to be the best material.

The state of atmosphere of the working rooms struck me as being good. The rooms looked somewhat untidy and dismal; but it was a very dull evening, with rain, when I was there.

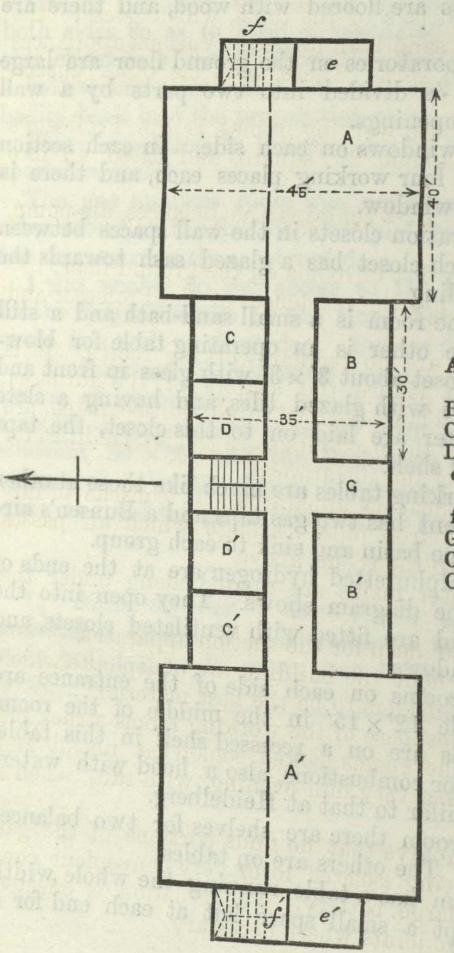
Professor Bunsen says that he finds portions of the gas and water pipes being isolated form very convenient conductors from his large battery. The isolation is effected by using caoutchouc joints where necessary.

AIX-LA-CHAPELLE.

I arrived here on the 8th June, but on going to the "Polytechnicum" I found that it was a holiday on account of a religious festival.

The following day I was able to see the chemical laboratories which, being the most recently constructed in Germany, I was told at other places would be well worth a visit.

The laboratory building is detached and at the back of the main building. It is divided by the entrance hall and staircase into two precisely similar parts, one is for technological the other for analytical chemistry.



A, A′ working rooms for 30 students each.
B, B′ Operation rooms.
C, C′ Balance room.
D, D′ Stores for chemicals.
e, e′ Rooms for sulphuretted hydrogen.
f, f′ Stairs to upper floor.
G Entrance.
Over A is a lecture room.
Over A′ a smaller lecture room, and a room for the technological collection.

The ground floor is appropriated to students' working rooms.

In the basement are to be operation rooms, furnaces, &c., but these are not yet fitted up.

On the first floor are the lecture rooms, library, gas analysis rooms, glass store and the Professor's office, and private laboratory.

Over the central portion of the building is a second storey containing living rooms for the Laboratory assistants, and the "Castellan."

The rooms throughout are heated by stoves. Those of the ground floor are about 18′ high; the first floor rather less, except the lecture rooms, which go through two storeys. The rooms are floored with wood, and there are no ventilators.

The students' laboratories on the ground floor are large airy rooms. Each is divided into two parts by a wall pierced with three openings.

There are three windows on each side. In each section are three groups of four working places each, and there is a place under each window.

There are evaporation closets in the wall spaces between the windows. Each closet has a glazed sash towards the outside of the building.

At one end of the room is a small sand-bath and a still apparatus. At the other is an operating table for blow-pipe, &c., and a closet about $3' \times 3'$ with glass in front and back, lined at sides with glazed tiles, and having a slate sill. Gas and water are laid on to this closet, the taps being on a recessed shelf.

The students' working tables are much like those at other places. Each student has two gas taps and a Bunsen's air-pump. There is one basin and sink to each group.

The rooms for sulphuretted hydrogen are at the ends of the building, as the diagram shows. They open into the working rooms and are fitted with ventilated closets, and have plenty of windows.

The operation rooms on each side of the entrance are fitted with a table $12' \times 15'$ in the middle of the room. Gas and water taps are on a recessed shelf in this table. There is a hood for combustions, also a hood with water-bath apparatus similar to that at Heidelberg.

In the balance room there are shelves for two balances fitted to the wall. The others are on tables.

The lecture room has a table running the whole width of the room, except a small space left at each end for a

passage. The top of the table is made of ground glass. There are holes in the table which can be closed by plugs, for suction by water on Bunsen's principle. Nozzles with taps for gas, water, and air at pressure are in a recessed shelf along the back of the table, where are also the taps for the water suction apparatus. Portable gasholders 3′ 6″ high × 2′ 6″ in diameter are used in the lecture room. Vertically over the front edge of the table a screen hangs down about 10′ from the ceiling; the room is about 28′ high. On the face of this screen are tables of atomic weights, &c. of the elements, behind it are the gas lights for lighting the lecture table and the diagrams. The rest of the room is lighted by a sunlight. There are no furnaces in the room. In the centre of the back wall is an opening 6′ wide glazed on both sides so as to form a ventilated closet. The sill of this closet is about 3′ from the floor and is formed by a hollow box which runs on rails and can thus be rolled bodily back into the preparation room.

There is nothing in the preparation room which calls for special remark.

The gas analysis room was not fitted up, nor were the other rooms on the first floor completely so, as the building has been so recently constructed.

I was unable to get access to the Physical Laboratory in the Polytechnicum at the time that I was there and I could not wait another day. But as far as I could make out it comprised the following rooms:—A room for the collection of apparatus, &c., about 65′ × 30′, a lecture room 45′ × 30′, a preparation room 20′ × 30′, a working room for students, 30′ × 30′, and the Professor's working room and office, each 14′ × 30′. These dimensions are only approximate, as I did not go into any of the rooms.

*** Since my visit I have learnt that the laboratory building at Zürich is to be extended to the length of the main building, or to more than twice its present dimensions.

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.
[9643.—100.—12/71.]

HMS
27.8.96
38041800134322